

LEVEL II

See also B059778L

①

PRESENTATION TO THE  
THE SIXTEENTH ANNUAL  
DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

AD A109414

TITLE: ANALYSIS OF DoD WEAPON SYSTEM COST GROWTH USING  
SELECTED ACQUISITION REPORTS (AS OF 31 DECEMBER 1980)

AUTHORS: GERALD R. McNICHOLS  
MANAGEMENT CONSULTING & RESEARCH, INC.

BRUCE J. McKINNEY  
MANAGEMENT CONSULTING & RESEARCH, INC.

DTIC  
ELECTE  
S JAN 5 1982 D  
D

DTIC FILE COPY

HOSTED BY THE COMPTROLLER OF THE ARMY  
SHERATON NATIONAL HOTEL  
ARLINGTON, VIRGINIA  
OCTOBER 4-7, 1981

DISTRIBUTION STATEMENT A  
Approved for public release;  
Distribution Unlimited

82 01 04 079

## PREFACE

Management Consulting & Research, Inc. (MCR) has been analyzing weapon system costs and cost growth problems for some time. This report documents the results of work performed for the Director, Cost & Economic Analysis, Office of the Assistant Secretary of Defense (Program Analysis & Evaluation), titled "Analysis of DoD Weapon System Cost Growth Using Selected Acquisition Reports," Contract Number MDA903-81-M-3057.

For this analysis the Selected Acquisition Reports (SARs) as of 31 December 1980 were used as the data base. A preliminary analysis of the 30 September 1980 SARs was also developed, but is not included in this report.

The report consists of a main "briefing" section, plus "back-up charts" in an Appendix including raw data and results from MCR's Selected Acquisition Report Analysis Model (SARAM). The Appendix also includes a brief analysis of the \$50B SAR Quarterly Growth (September-December 1980), the largest in history. In addition tables are presented which note the difference between the DSARC II date (assumed herein) and the approved DCP dates (assumed by OASD-Comptroller).

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By Per DTIC Form 50	
Distribution/on File	
Availability Codes	
Dist	Avail and/or Special
A	

## INTRODUCTION

The Office of the Secretary of Defense uses performance measurement systems to evaluate major contract status in terms of cost, schedule and technical accomplishments. One of the key documents which provides summary level information is the Selected Acquisition Report (SAR) sent quarterly to Congress.

The analysis reported here is as of December 1980, with 55 weapon systems being reported. Data was used as reported in the SAR. There are in several instances problems with (1) data validity, (2) escalation adjustments, or (3) quantity change calculations. Recent changes in the SAR process (as noted in DoD Guide 7000.3, "Preparation and Review of Selected Acquisition Reports," May 1980) are now being implemented to correct these deficiencies. Older programs, however, cannot be totally corrected instantaneously.

Clearly the importance of correct and sufficient data can not be over emphasized, as the validity of any analysis is jeopardized by the absence of these qualities. However, even with the data as reported, the major conclusion is that analysis of SARs is worthwhile as a general indicator of weapon system cost status.

The computer outputs were generated by the Selected Acquisition Report Analysis Model (SARAM) developed by Management Consulting & Research, Inc. (MCR), Falls Church, Virginia.

THIS BRIEFING COVERS THE TOPICS SHOWN HERE.  
AN APPENDIX IS ALSO INCLUDED WITH A NUMBER OF  
BACK-UP CHARTS WHICH MAY BE USEFUL TO DIFFERENT  
AUDIENCES.

# ANALYSIS OF WEAPON SYSTEM COST GROWTH

## TOPICS

- WEAPON SYSTEM COSTS
  - BACKGROUND/DEFINITIONS
  - TYPICAL WEAPON SYSTEM PROGRAM CYCLE
  - MAGNITUDE OF COST GROWTH
  - TREND ANALYSIS
  - 76 - 80 COMPARISON BY PROGRAM BY SERVICE
  - COST GROWTH CATEGORY

THE SELECTED ACQUISITION REPORTS (SARs) ARE STANDARD, COMPREHENSIVE, SUMMARY STATUS REPORTS PREPARED ON A QUARTERLY BASIS FOR EACH "MAJOR" WEAPON SYSTEM.

A SAR CONTAINS THE FOLLOWING INFORMATION:

- PROGRAM SUMMARY
- OPERATIONAL/TECHNICAL CHARACTERISTICS
- SCHEDULE MILESTONES
- ACQUISITION COST
- CONTRACTOR COST
- VARIANCE ANALYSES
- BUDGET YEAR AND OUT YEAR PROGRAMS
- COST QUANTITY CURVES.

THE SAR THUS PROVIDES A CONSISTENT, QUARTERLY SUMMARY OF THE STATUS OF EACH MAJOR ACQUISITION PROGRAM WITH PROGRAM COST AND CHANGES IN COST BEING A LARGE PORTION OF THE PRESENTED INFORMATION. MOST OF THE SARs ARE CURRENTLY TRANSMITTED TO THE CONGRESS AT THEIR REQUEST.

# SELECTED ACQUISITION REPORTS (SARs)

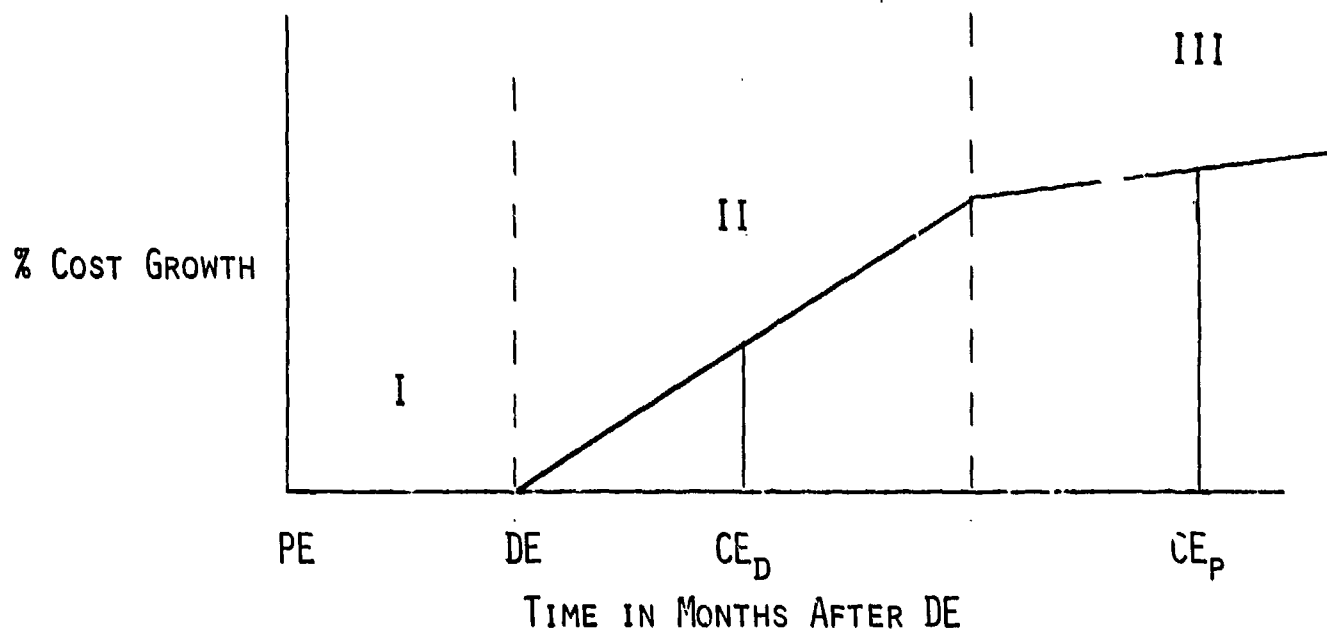
- STANDARD, COMPREHENSIVE, SUMMARY STATUS REPORT  
ON MAJOR DoD ACQUISITION SYSTEMS
  - INITIATED - FALL 1967
  - REQUESTED BY SASC - APRIL 1969
  - LEGALLY REQUIRED BY PL 94-106 - 1975  
(FY76 APPROPRIATIONS BILL)
- "MAJOR" SYSTEMS DEFINITION FORMALIZED BY  
PL 96-107 - NOVEMBER 1979
  - \$75M RDT&E
  - \$300M PROCUREMENT (INVESTMENT)

A TYPICAL WEAPON SYSTEM PROGRAM UNDERGOES COST GROWTH RELATED TO PROGRAM MILESTONES. A PLANNING ESTIMATE (PE) IS DEVELOPED AT THE TIME THE SECRETARY OF DEFENSE APPROVES PROGRAM INITIATION. MILESTONE I (ADVANCED DEVELOPMENT) IS CONSIDERED AS PROGRAM INITIATION FOR SAR PURPOSES. A DEVELOPMENT ESTIMATE (DE) IS MADE AT THE TIME FULL-SCALE ENGINEERING DEVELOPMENT IS INITIATED, CALLED MILESTONE II. THE DE SERVES AS THE BASELINE TO WHICH ALL PROGRAM CHANGES ARE THEN COMPARED. THE MAJORITY OF THE PROGRAM COST GROWTH IS OBSERVED TYPICALLY IN THE TIME PERIOD AFTER MILESTONE II AND PRIOR TO MILESTONE III, APPROVAL FOR PRODUCTION. PROGRAM COST GROWTH TYPICALLY CONTINUES IN THE PRODUCTION PHASE, ALTHOUGH AT A MUCH LOWER RATE.

BECAUSE OF THE "MATURING" OF PROGRAMS OVER TIME, IT IS BENEFICIAL TO SEPARATE COST GROWTH INTO TWO CATEGORIES CORRESPONDING TO SYSTEMS IN (1) DEVELOPMENT, OR (2) PROCUREMENT.



# TYPICAL PROGRAM CYCLE



PE - PLANNING ESTIMATE  
DE - DEVELOPMENT ESTIMATE  
 $CE_D$  - CURRENT ESTIMATE (FOR SYSTEMS IN DEVELOPMENT)  
 $CE_P$  - CURRENT ESTIMATE (FOR SYSTEMS IN PROCUREMENT)

THE MAGNITUDE OF COST GROWTH WILL VARY WITH THE DEFINITION USED FOR COST GROWTH. THERE ARE CURRENTLY THREE VIEWS ON COST GROWTH:

- CURRENT "THEN-YEAR" DOLLARS - THIS VIEW IS IMPORTANT IN TERMS OF MEASURING BUDGET EFFECTS SINCE IT INCLUDES ALL PROGRAM CHANGES AND INFLATION. A PROGRAM CAN SHOW COST GROWTH DUE ONLY TO INFLATION SINCE ESCALATION RATES USED IN DEVELOPING THE CURRENT OUT-YEAR BUDGETS ARE LIKELY TO BE DIFFERENT FROM THE RATES USED FOR THE DEVELOPMENT ESTIMATE. SCHEDULE SLIPPAGE CAN ALSO CAUSE SIGNIFICANT GROWTH ATTRIBUTABLE ONLY TO INFLATION.
- CONSTANT "BASE-YEAR" DOLLARS - THIS VIEW IS IMPORTANT IN MEASURING PROGRAM MANAGEMENT EFFECTS. COST GROWTH DUE TO INFLATION IS NOT INCLUDED.
- QUANTITY ADJUSTMENT - THIS VIEW IS IMPORTANT TO ACCURATELY COMPARE THE DEVELOPMENT ESTIMATE (DE) TO THE CURRENT ESTIMATE (CE). THE ADJUSTMENT IS MADE IN BASE-YEAR DOLLARS TO EXCLUDE THE GROWTH DUE TO INFLATION. IN ADDITION THE DE BASELINE IS ADJUSTED TO REFLECT THE QUANTITY CHANGE IN BASE-YEAR DOLLARS. THE ADJUSTED DE GIVES THE COST THAT WOULD HAVE BEEN ESTIMATED AT MILESTONE II FOR THE CURRENT QUANTITY.

# COST MAGNITUDE

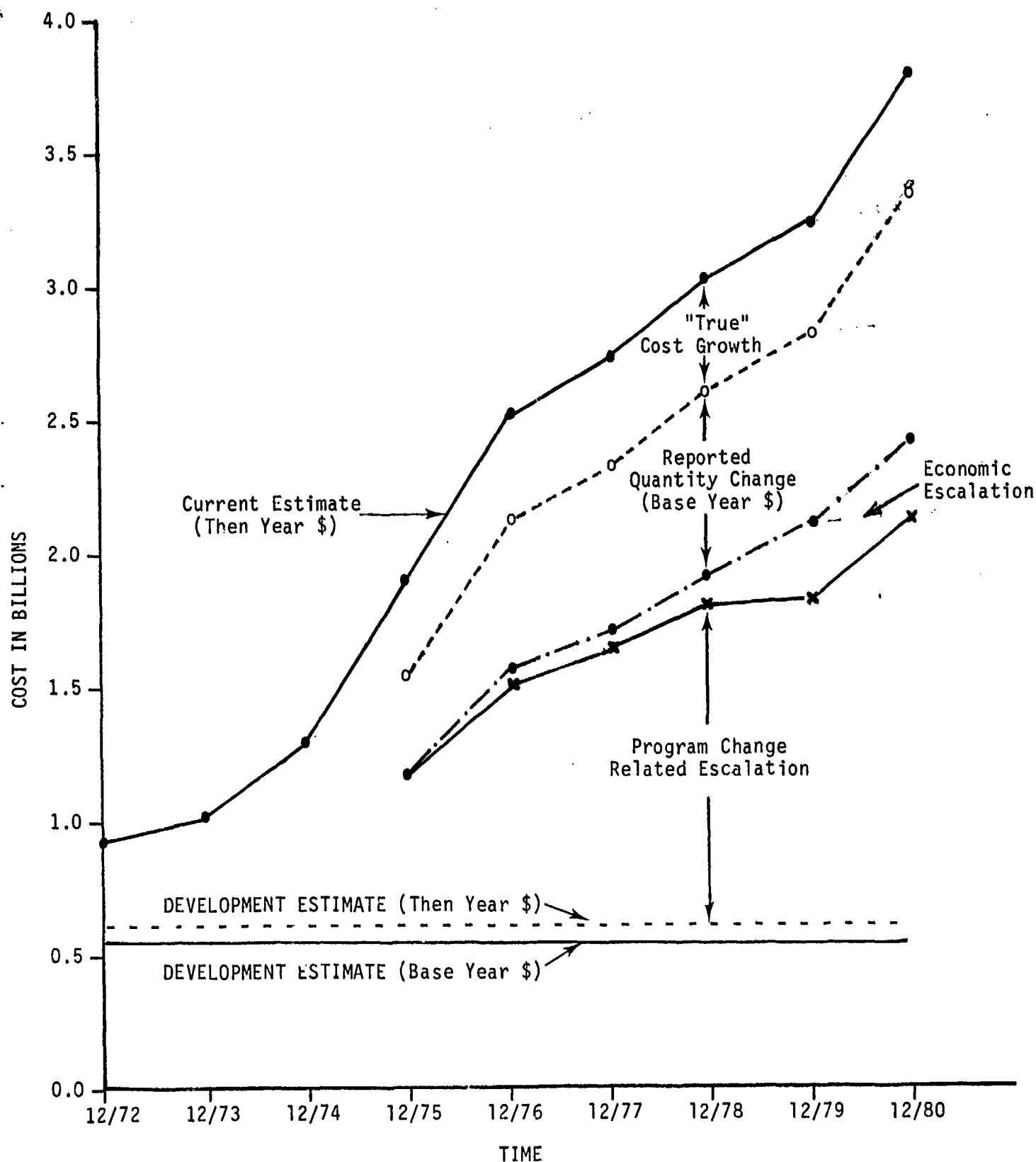
- THREE VIEWS ON "COST GROWTH"
- CURRENT "THEN-YEAR" DOLLARS: IMPORTANT IN MEASURING BUDGET EFFECTS (INFLATION IMPACT)
- CONSTANT "BASE-YEAR" DOLLARS: IMPORTANT IN MEASURING PROGRAM MANAGEMENT EFFECTS
- QUANTITY ADJUSTMENT: IMPORTANT IN ACCURATELY COMPARING DEVELOPMENT ESTIMATE (DE) TO CURRENT ESTIMATE (CE)

THE E-2C PROGRAM COST HISTORY IS PRESENTED AS AN EXAMPLE OF THE TYPES OF COST GROWTH. THE COSTS SHOWN REFLECT THE DECEMBER SAR OF EACH YEAR. THE CURRENT ESTIMATE (THEN YEAR \$) LINE SHOWS THAT THE TOTAL PROGRAM COSTS CONTINUE TO INCREASE. THIS IS THE COST GROWTH THE CONGRESS TENDS TO POINT TO AS A BUDGET EFFECT. THE "TRUE" COST GROWTH REGION REPRESENTS BASE-YEAR DOLLAR GROWTH DUE TO ALL PROGRAM CHANGES EXCEPT QUANTITY. "TRUE" COST GROWTH HAS REMAINED ESSENTIALLY CONSTANT FOR THE LAST 4 YEARS. A LARGE PORTION OF THE PROGRAM GROWTH IS DUE TO REPORTED QUANTITY CHANGES (BASE YEAR \$). HERE THE TOTAL QUANTITY PROCURED HAS INCREASED. THE FIGURE ILLUSTRATES THE NEED TO MAKE THE QUANTITY ADJUSTMENT WHEN CALCULATING COST GROWTH. THE NEXT REGION IS COST GROWTH DUE TO CHANGES IN ESCALATION RATES, WHICH IS CALLED ECONOMIC ESCALATION IN THE SARs. THE LARGEST CATEGORY FOR PROGRAM COST GROWTH IS PROGRAM CHANGE RELATED ESCALATION. THIS CATEGORY INCLUDES THE ESCALATION (OR INFLATION) ASSOCIATED WITH ALL PROGRAM CHANGES, (QUANTITY, SCHEUDLE, ESTIMATING, ENGINEERING, OR OTHERS). AFTER REMOVING THE VARIOUS COST CHANGES FROM THE CURRENT ESTIMATE (THEN YEAR \$), THE DEVELOPMENT ESTIMATE (THEN YEAR \$) REMAINS. THE DIFFERENCE BETWEEN THE DE IN THEN YEAR \$ AND THE DE IN BASE YEAR \$ WAS THE PRE-PLANNED INFLATION INCLUDED IN THE DE.

COST GROWTH FIGURES FOR THE THREE VIEWS ARE:

- CURRENT "THEN YEAR" DOLLARS - 542.5%
- CONSTANT "BASE YEAR" DOLLARS - 242.7%
- QUANTITY ADJUSTMENT "TRUE" COST GROWTH - 36.3%

# E-2C PROGRAM COST HISTORY



THE SAR PROGRAM COST SUMMARY PRESENTS THE COST GROWTH FIGURES BASED ON THE TOTAL COSTS FOR 55 SAR SYSTEMS. THE 55 SYSTEMS INCLUDE THE NON-CONGRESSIONAL SARs AND COUNT CERTAIN AIR FORCE AND NAVY PROGRAMS AS SEPARATE ENTITIES, (E.G., AIM-9M, AIM-7M).

THE % GROWTH: UNADJUSTED FIGURE OF 129.9% REPRESENTS THE COST GROWTH BASED ON CURRENT THEN YEAR DOLLARS. IT INCLUDES ALL PROGRAM CHANGES AND ESCALATION. IT CORRESPONDS TO THE FIRST VIEW OF COST GROWTH.

THE % GROWTH: ADJUSTED FOR QUANTITY FIGURE OF 71.3% REPRESENTS COST GROWTH BASED ON CURRENT THEN YEAR DOLLARS BUT INCREASING THE DE BASELINE TO THE CURRENT QUANTITY. THE QUANTITY INCREASE COSTING \$47.3B IN THEN YEAR DOLLARS IS ADDED TO ARRIVE AT THE \$185.6B ADJUSTED BASELINE.

THE % GROWTH: ADJUSTED FOR QUANTITY AND ESCALATION OF 25.4% REPRESENTS COST GROWTH BASED ON BASE YEAR DOLLARS. IT CORRESPONDS TO THE THIRD VIEW OF COST GROWTH, WHAT WE CALLED "TRUE" COST GROWTH.

THE % GROWTH OF INFLATION FIGURE OF 152.4% INDICATES THAT INFLATION IS THE MAJOR CONTRIBUTOR TO COST GROWTH. THE INCREASE FROM \$67.2B PLANNED ESCALATION, TO \$169.6B CURRENTLY ESTIMATED FOR TOTAL ESCALATION, IS A LARGER PERCENTAGE INCREASE THAN ANY FIGURE SHOWN. THE INFLATION TOTAL IS LARGER THAN THE BASE YEAR TOTAL, (I.E., MORE THAN HALF THE COST OF THE CURRENT ESTIMATE, FOR THESE 55 WEAPON SYSTEMS).

# SAR PROGRAM COST SUMMARY

## AS OF 31 DECEMBER 1980

### 55 SYSTEMS - DOLLAR COMPARISON

DOLLAR MEASURE	DEVELOPMENT ESTIMATE (DE)	DE ADJUSTED FOR QUANTITY	OTHER PROGRAM CHANGES	ECONOMIC ESCALATION	CURRENT ESTIMATE	% GROWTH ADJUSTED FOR QUANTITY
CURRENT	\$138.3B	\$185.6B	\$84.2B	\$48.2B	\$318.0B	71.3%
BASE YEAR	\$101.4B	\$118.4B	\$30.1B	---	\$148.4B	25.4%
		\$ 67.2B			\$169.6B	152.4%

$$\% \text{ GROWTH: UNADJUSTED} = \frac{(318.0 - 138.3)}{138.3} = 129.9\%$$

$$\% \text{ GROWTH: ADJUSTED FOR QUANTITY} = \frac{(318.0 - 185.6)}{185.6} = 71.3\%$$

$$\% \text{ GROWTH: ADJUSTED FOR QUANTITY AND ESCALATION} = \frac{(148.4 - 118.4)}{118.4} = 25.4\%$$

$$\% \text{ GROWTH OF INFLATION} = \frac{(169.6 - 67.2)}{67.2} = 152.4\%$$

THE 55 SYSTEMS CAN ALSO BE GROUPED ACCORDING TO SERVICE: 17 ARMY SYSTEMS, 15 AIR FORCE SYSTEMS, 23 NAVY SYSTEMS. THE ARMY HAS EXPERIENCED MORE COST GROWTH THAN EITHER THE AIR FORCE OR THE NAVY IN CONSTANT (BASE YEAR) DOLLARS OR CURRENT (THEN YEAR) DOLLARS. BECAUSE OF THE DIFFERENT MIX OF SYSTEMS IN EACH SERVICE, ONE SHOULD NOT JUMP TO ANY STRONG CONCLUSIONS FROM THIS COMPARISON. FURTHER ANALYSIS IS NEEDED.



# SAR PROGRAM COST SUMMARY

## AS OF 31 DECEMBER 1980

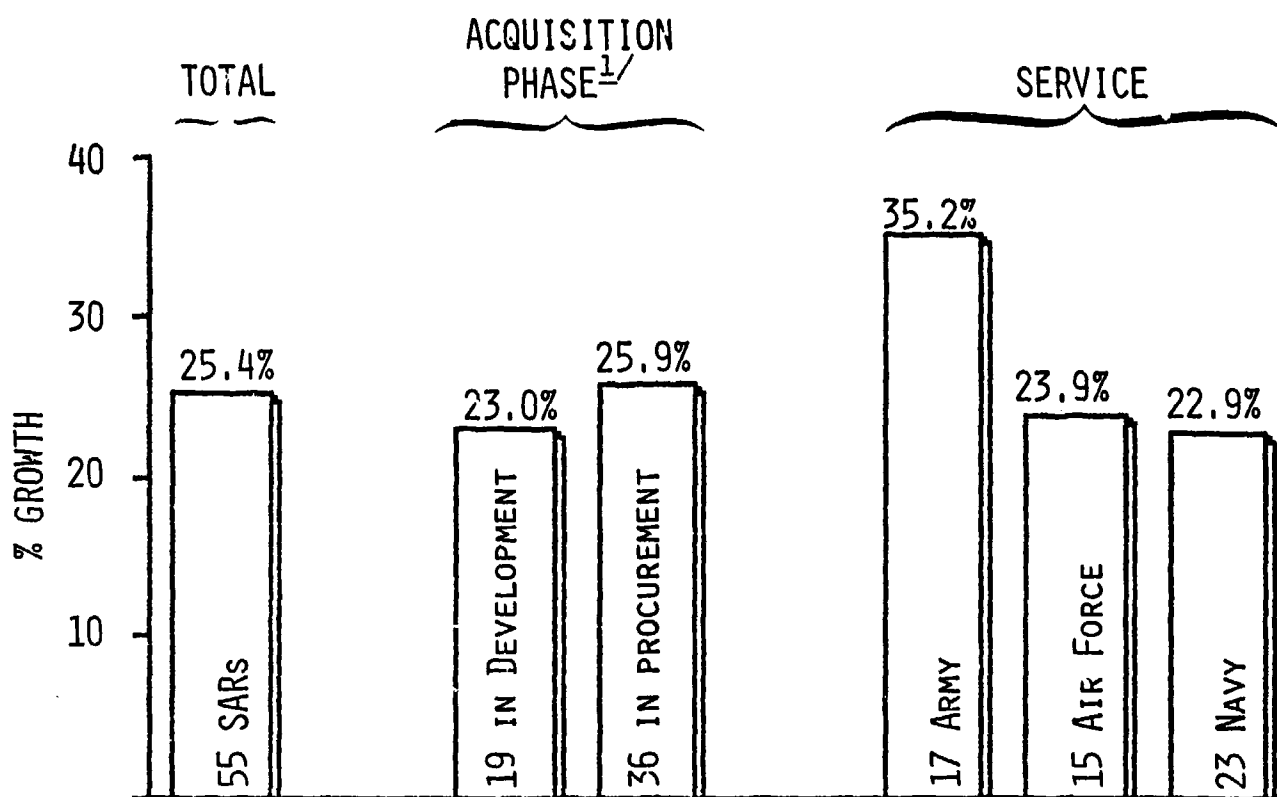
### 55 SYSTEMS - DOLLAR COMPARISON (\$ BILLIONS)

SERVICE	MEASURE	DEVELOPMENT ESTIMATE	DEVELOPMENT ESTIMATE ADJUSTED FOR QUANTITY	OTHER PROGRAM CHANGES	ECONOMIC ESCALATION	CURRENT ESTIMATE	PER CENT GROWTH ADJUSTED FOR QUANTITY
ARMY (17)	CURRENT	32.5	36.6	28.3	12.6	77.5	111.7%
	BASE YEAR	21.8	21.9 <u>14.7</u>	7.7	----	29.6 <u>47.9</u>	35.2% <u>225.8%</u>
AIR FORCE (15)	CURRENT	32.8	41.4	17.1	12.0	70.5	70.2%
	BASE YEAR	24.3	28.2 <u>13.2</u>	6.7	----	34.9 <u>35.6</u>	23.9% <u>169.1%</u>
NAVY (23)	CURRENT	72.9	107.6	38.8	23.6	170.0	58.0%
	BASE YEAR	55.3	68.3 <u>39.3</u>	15.6	----	83.9 <u>86.1</u>	22.9% <u>119.1%</u>

THE CONSTANT DOLLAR COST GROWTH ADJUSTED FOR QUANTITY FOR THE 55 SYSTEMS CAN BE SUMMARIZED AS SHOWN. THE 55 SYSTEMS ARE GROUPED ACCORDING TO ACQUISITION PHASE AND SERVICE. THERE IS LITTLE DIFFERENCE BETWEEN THE PERCENTAGES FOR THE ACQUISITION PHASES. THE COST GROWTH FOR SYSTEMS IN PROCUREMENT IS THE CUMULATIVE GROWTH BETWEEN THE CURRENT ESTIMATE AND THE DEVELOPMENT ESTIMATE. IT THUS INCLUDES THE LARGE COST GROWTH TYPICALLY OBSERVED PRIOR TO MILESTONE III APPROVAL FOR PRODUCTION, AS WELL AS THE USUALLY SMALLER GROWTH FOR SYSTEMS WHICH OCCURS AFTER MILESTONE III. IT IS LIKELY THAT THE CURRENT DEVELOPMENT SYSTEMS WILL EXHIBIT CONTINUED COST GROWTH. THE PROBLEM OF WEAPON SYSTEM "AFFORDABILITY" MAY NOT BE DIMINISHING.

IN FACT, THE HIGH GROWTH CURRENTLY ESTIMATED FOR THE 19 SYSTEMS STILL IN DEVELOPMENT MAY BE A BAD SIGN IF THE TYPICAL PROGRAM CYCLE SHOWN EARLIER HOLDS TRUE. THE DIFFERENCE BETWEEN 30 SEPTEMBER 1980 ESTIMATES (12.4% GROWTH) AND 31 DECEMBER 1980 ESTIMATES (23% GROWTH) IS DESCRIBED IN THE APPENDIX.

# REAL COST GROWTH BY ACQUISITION PHASE AND BY SERVICE (31 DECEMBER 1980, BASE YEAR \$, DE ADJUSTED FOR QUANTITY)

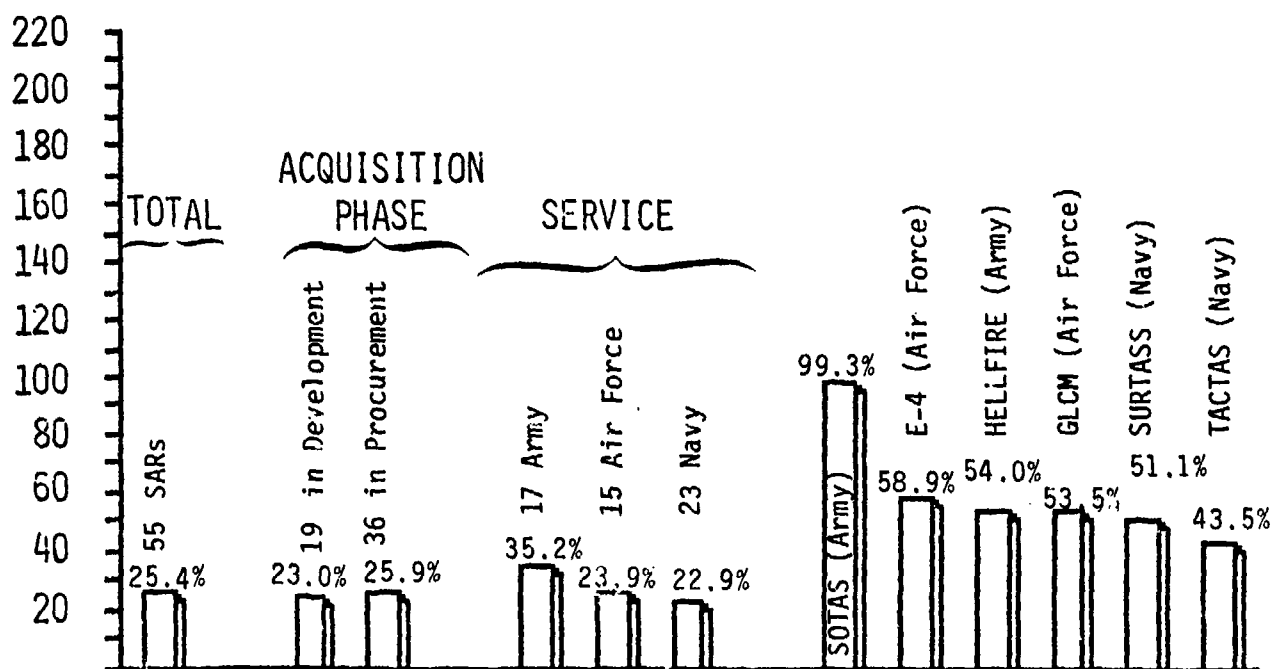


1/ Cost growth in Procurement is cumulative, including cost growth in Development

INDIVIDUAL HIGH COST GROWTH SYSTEMS STILL IN DEVELOPMENT (TWO PER SERVICE) ARE COMPARED TO THE TOTAL, ACQUISITION PHASE, AND SERVICE COST GROWTH PERCENTAGES. SINCE THESE SIX SYSTEMS STILL IN DEVELOPMENT ARE ALREADY ESTIMATED AS HAVING COST GROWTH MORE THAN TWICE THE AVERAGE, THEY SHOULD BE WATCHED CLOSELY.

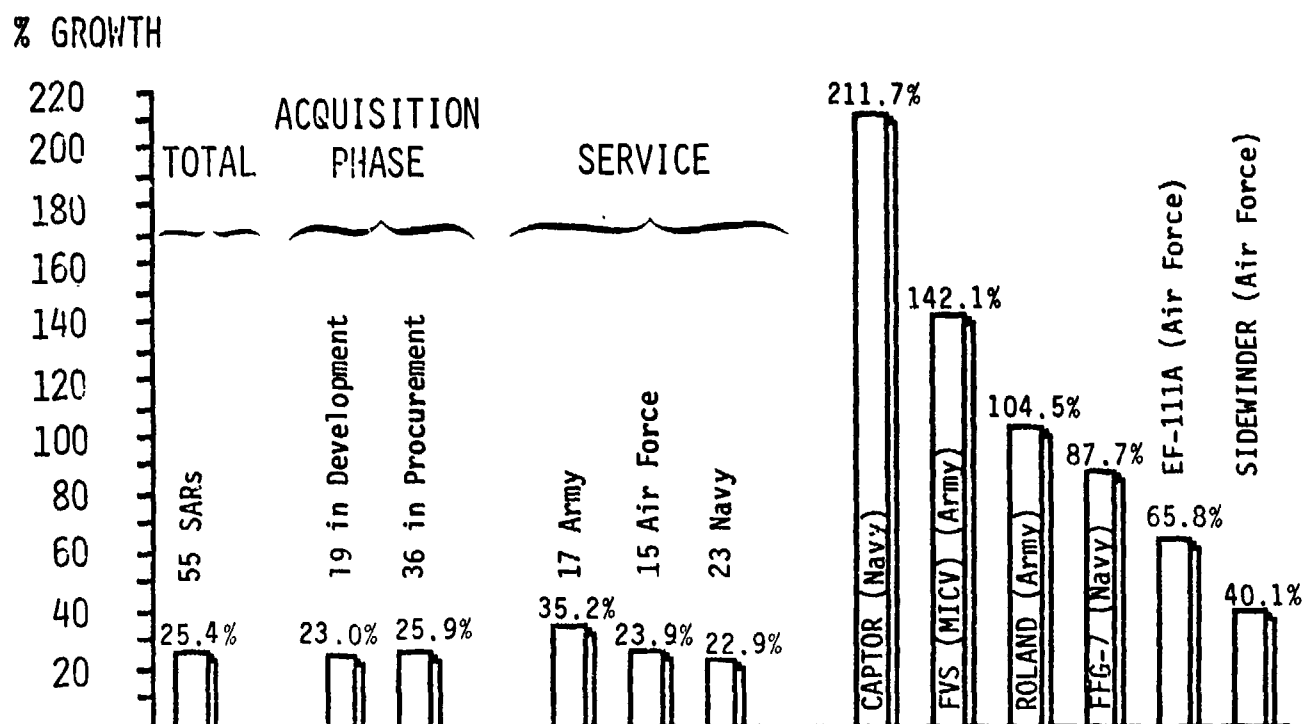
# 

% GROWTH



INDIVIDUAL HIGH COST GROWTH SYSTEMS NOW IN THE  
PROCUREMENT PHASE OF ACQUISITION ARE COMPARED TO THE  
TOTAL, ACQUISITION PHASE AND SERVICE COST GROWTH PER-  
CENTAGES. IT MAY BE TOO LATE TO EFFECT CHANGES  
WHICH WOULD REDUCE COST FOR THESE SYSTEMS.

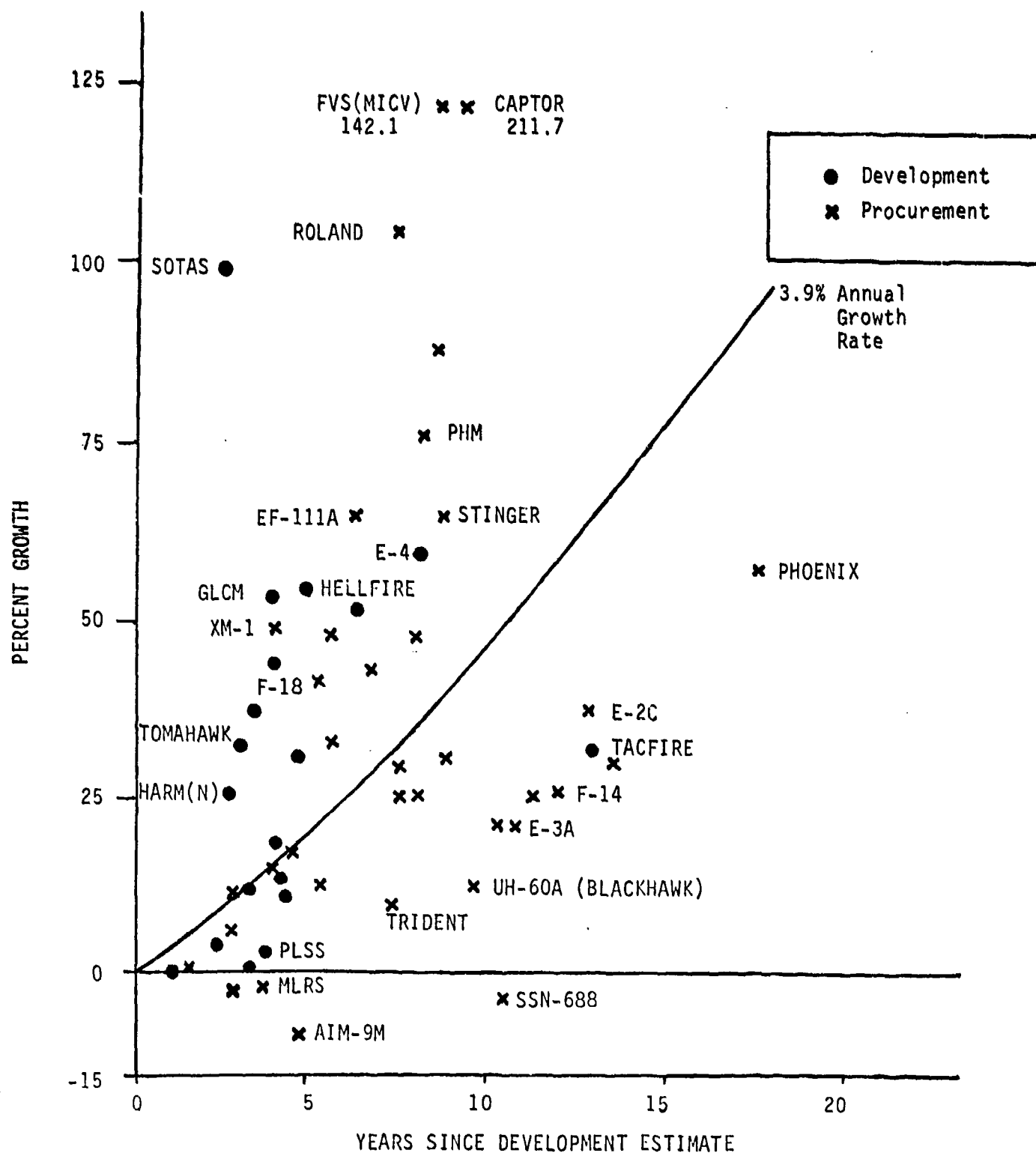
# **HIGH COST GROWTH** **PROCUREMENT SYSTEMS** **(BASE YEAR \$, DE ADJUSTED** **FOR QUANTITY)**



INDIVIDUAL PROGRAM PERCENT COST GROWTH IS PLOTTED AGAINST "AGE" OF THE SYSTEM MEASURED IN YEARS SINCE DEVELOPMENT ESTIMATE. WE'VE USED THE DSARC II DATE AS THE DE TIME. SOME REPRESENTATIVE PROGRAMS ARE IDENTIFIED AND THE DISTINCTION IS MADE BETWEEN DEVELOPMENT AND PROCUREMENT PROGRAMS. AN ANNUAL GROWTH RATE OF 3.9% IS COMPUTED FOR THE 55 SAR PROGRAMS. A CHART AND SEVERAL TABLES IN THE APPENDIX SHOW MORE DETAIL BY SERVICE.

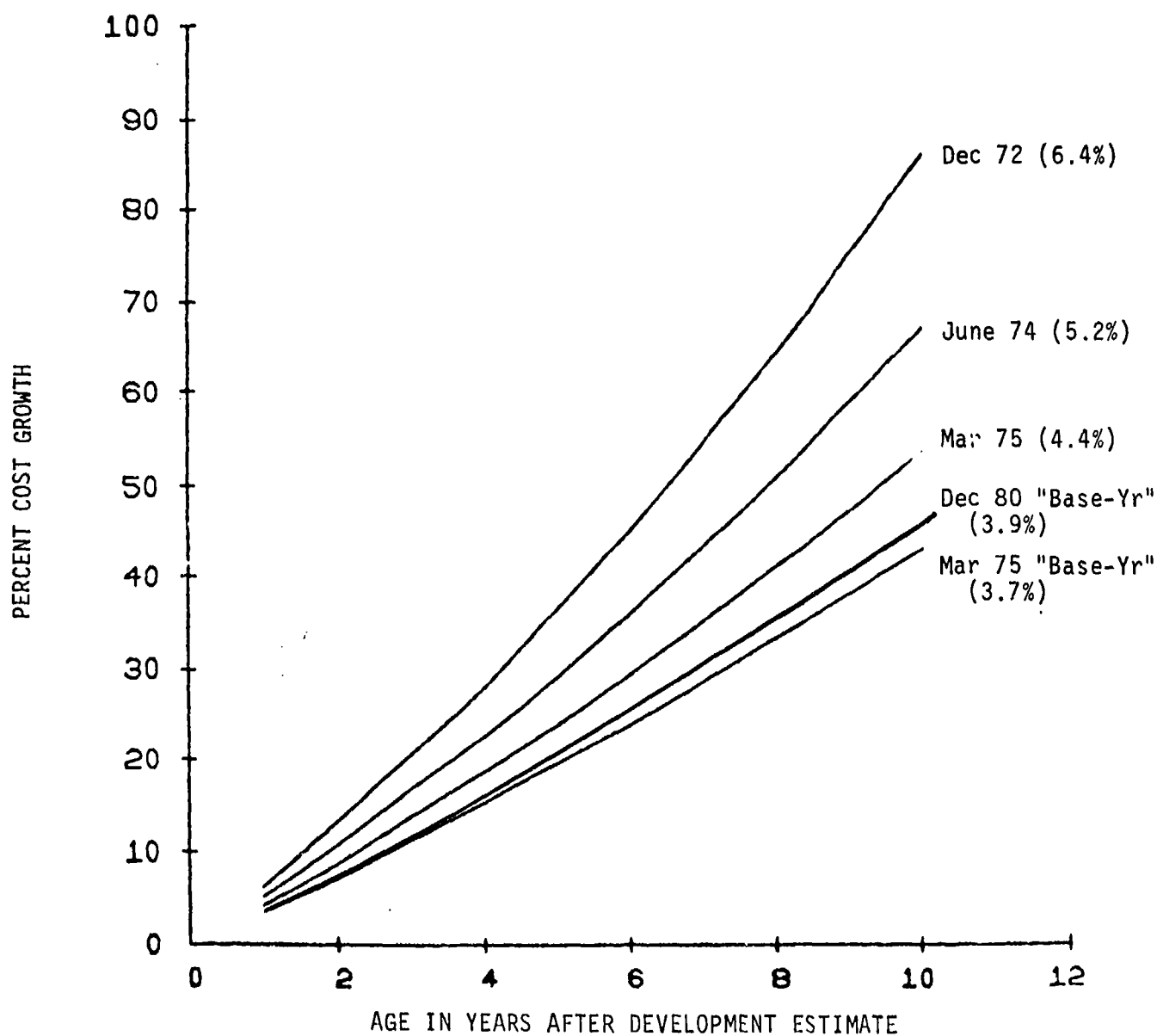


# AS OF 31 DECEMBER 1980 (BASE YEAR \$, DE ADJUSTED FOR QUANTITY)



A HISTORY OF ANNUAL GROWTH RATES FOR THE SAR SYSTEMS IS SHOWN. FROM 1972, THE YEAR THE COST ANALYSIS IMPROVEMENT GROUP (CAIG) WAS FORMED, UNTIL 1975 MAJOR REDUCTIONS IN ANNUALIZED COST GROWTH WERE ACHIEVED. THESE DATA WERE IN THEN YEAR DOLLARS BECAUSE THE BASE YEAR DOLLAR REPORTING REQUIREMENT WAS NOT INITIATED UNTIL 1975. THE MARCH 1975 AND DECEMBER 1980 FIGURES ARE BASE YEAR DOLLARS ADJUSTED FOR QUANTITY. THE COST GROWTH FIGURES FOR MARCH 1975 (3.7%) AND DECEMBER 1980 (3.9%) ARE ROUGHLY EQUIVALENT GIVEN THE STATISTICAL UNCERTAINTY OF THE ESTIMATING PROCESS.

# HISTORY OF ANNUALIZED SAR PROGRAM GROWTH RATES (46 SARs-DEC 72, 53 SARs-JUNE 74, 50 SARs-MAR 75, 55 SARs-DEC 80)



ANNUAL GROWTH RATES FOR EACH SERVICE AND BY ACQUISITION PHASE ARE PRESENTED. THE ARMY SHOWS A LOWER GROWTH RATE FOR SYSTEMS IN DEVELOPMENT AND A HIGHER GROWTH RATE FOR SYSTEMS IN PROCUREMENT WHEN COMPARED TO THE OTHER SERVICE FIGURES. THE AIR FORCE SHOWS THE LOWEST RATE FOR SYSTEMS IN PROCUREMENT AND ROUGHLY THE SAME RATE AS THE ALL SERVICE FIGURES FOR DEVELOPMENT AND IN TOTAL. THE NAVY SHOWS A MUCH HIGHER RATE FOR PROGRAMS IN DEVELOPMENT AND ROUGHLY THE SAME RATES FOR THE OTHER TWO CATEGORIES. GIVEN THE NUMBER OF SYSTEMS, THE NAVY DEVELOPMENT COST GROWTH RATE IS SOMEWHAT ALARMING.

# PER CENT ANNUAL GROWTH RATES AS OF 12/80 (NUMBER OF SYSTEMS)

<u>SERVICE</u>	<u>DEVELOPMENT</u>	<u>PROCUREMENT</u>	<u>TOTAL</u>
ARMY	(6) 3.7	(11) 4.8	(17) 4.5
AIR FORCE	(7) 5.0	(8) 3.1	(15) 3.6
NAVY	(6) 7.8	(17) 3.5	(23) 3.8
ALL	(19) 4.9	(36) 3.8	(55) 3.9

COST GROWTH FIGURES FOR SYSTEMS FOR THE PERIOD DECEMBER 1976 TO DECEMBER 1980 ARE SHOWN. THE ARMY SHOWS AN AVERAGE (AGGREGATE) PERCENT GROWTH OF 31.1% FOR NINE SYSTEMS. THIS 31.1% OVERALL GROWTH IS THE EQUIVALENT OF A 7.0% ANNUALIZED GROWTH RATE. THE AIR FORCE AND NAVY FIGURES ARE CONSIDERABLY LESS THAN THE ARMY FIGURES, BUT THE MIX OF TYPES OF SYSTEMS IS CLEARLY DIFFERENT FOR THE THREE SERVICES.

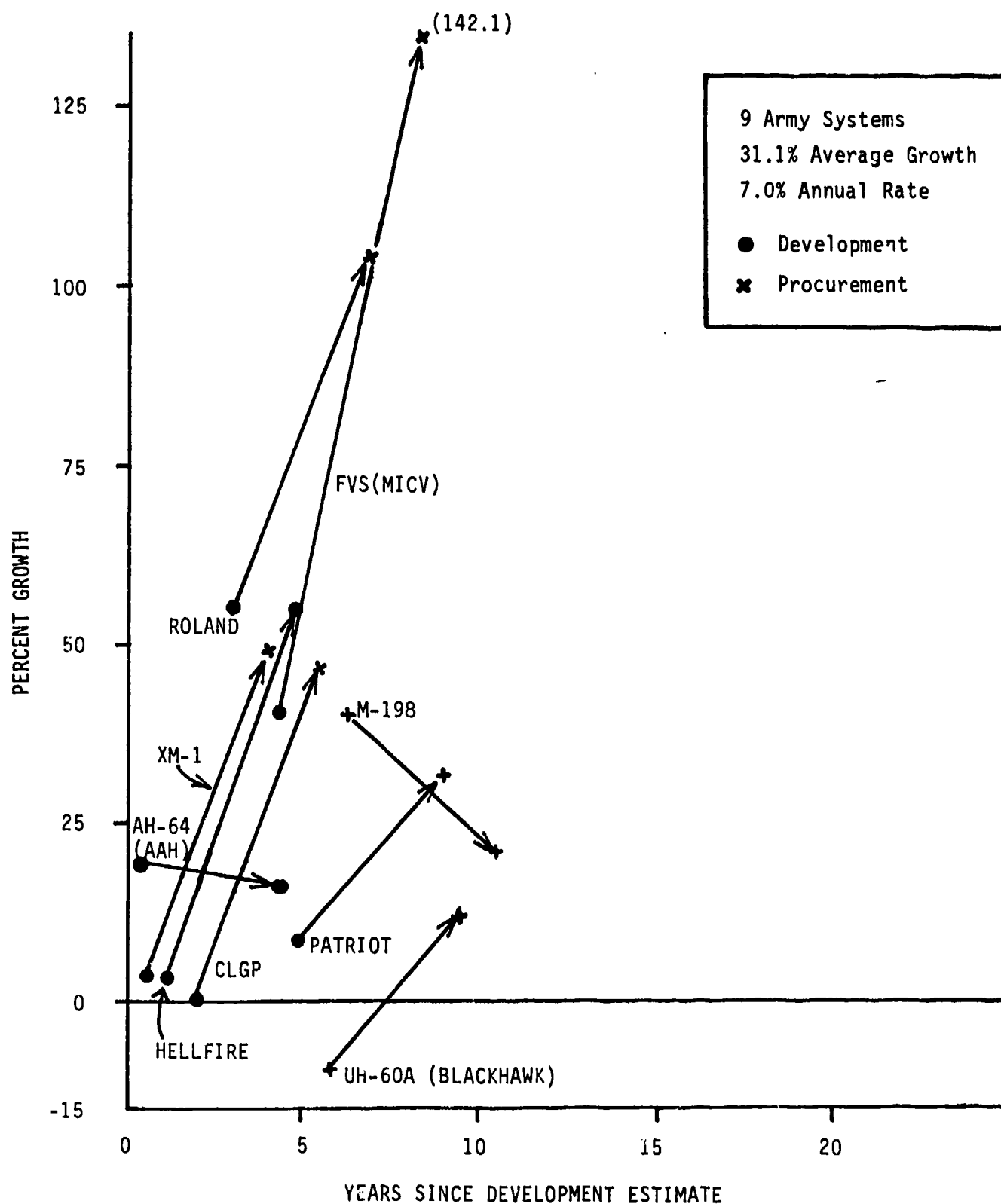
# COST GROWTH - 12/76 TO 12/80 SUMMARY

<u>SERVICE</u>	<u>SYSTEMS</u>	<u>AVERAGE % GROWTH OVER PERIOD</u>	<u>ANNUALIZED % GROWTH</u>
ARMY	9	31.1	7.0
AIR FORCE	7	14.2	-3.4
NAVY	11	12.2	2.9
ALL	27	19.0	4.4

THE COST GROWTH STATUS OF THE NINE ARMY SYSTEMS  
IS DISPLAYED. MOST SYSTEMS MADE THE TRANSITION FROM  
DEVELOPMENT TO PROCUREMENT IN THIS TIME PERIOD. MOST  
SYSTEMS ALSO SHOW CONSIDERABLE COST GROWTH FOR THE  
PERIOD.



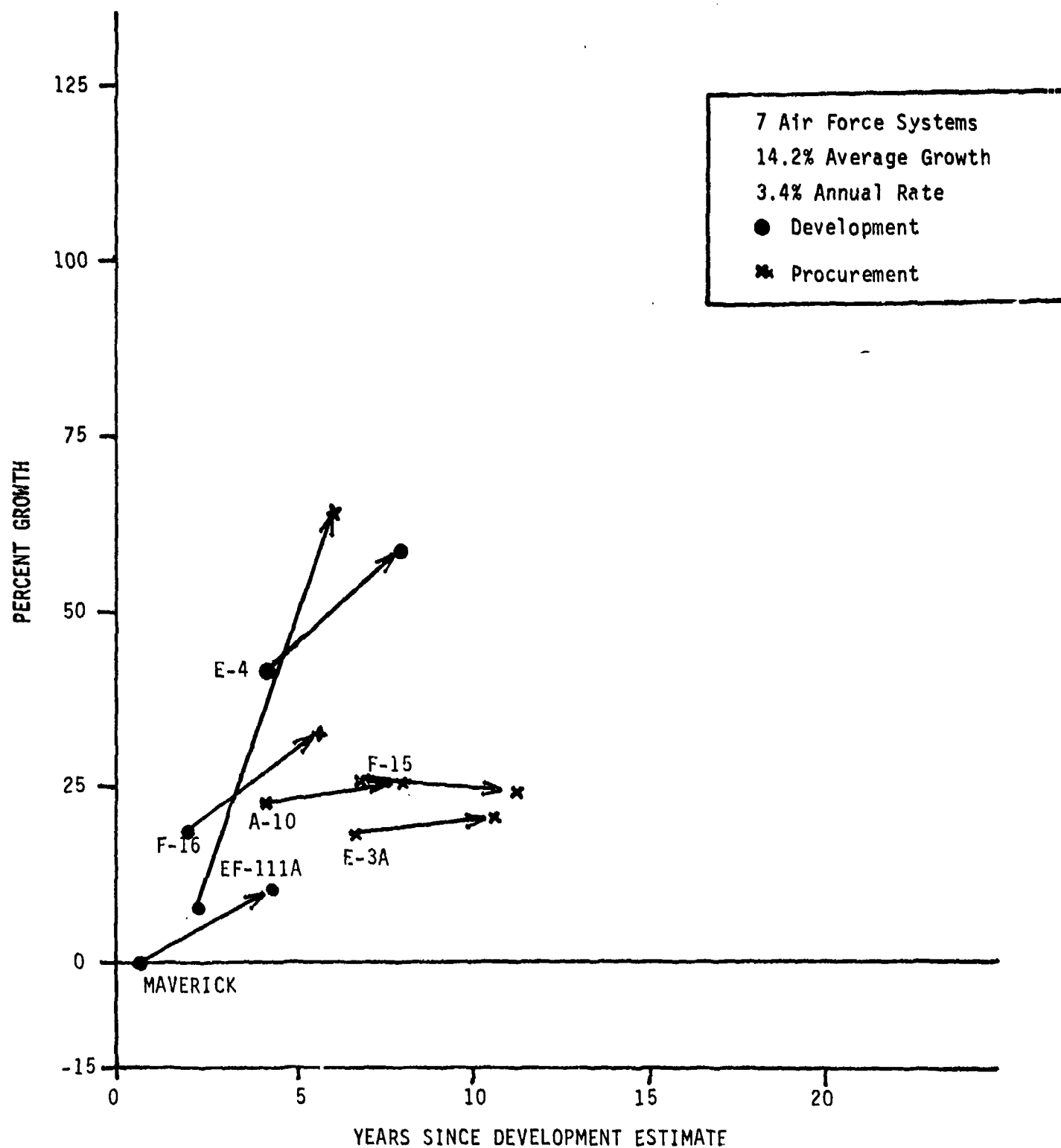
# COST GROWTH - 12/76 TO 12/80 (BASE YEAR \$, DE ADJUSTED FOR QUANTITY)



THE COST GROWTH STATUS OF THE SEVEN AIR FORCE SYSTEMS IS DISPLAYED. SEVERAL SYSTEMS EXHIBIT ONLY NOMINAL COST GROWTH FOR THE PERIOD. NOTE THAT THE A-10, F-15, AND E-3A WERE IN PROCUREMENT DURING THIS FOUR-YEAR PERIOD.

# COST GROWTH - 12/76 TO 12/80

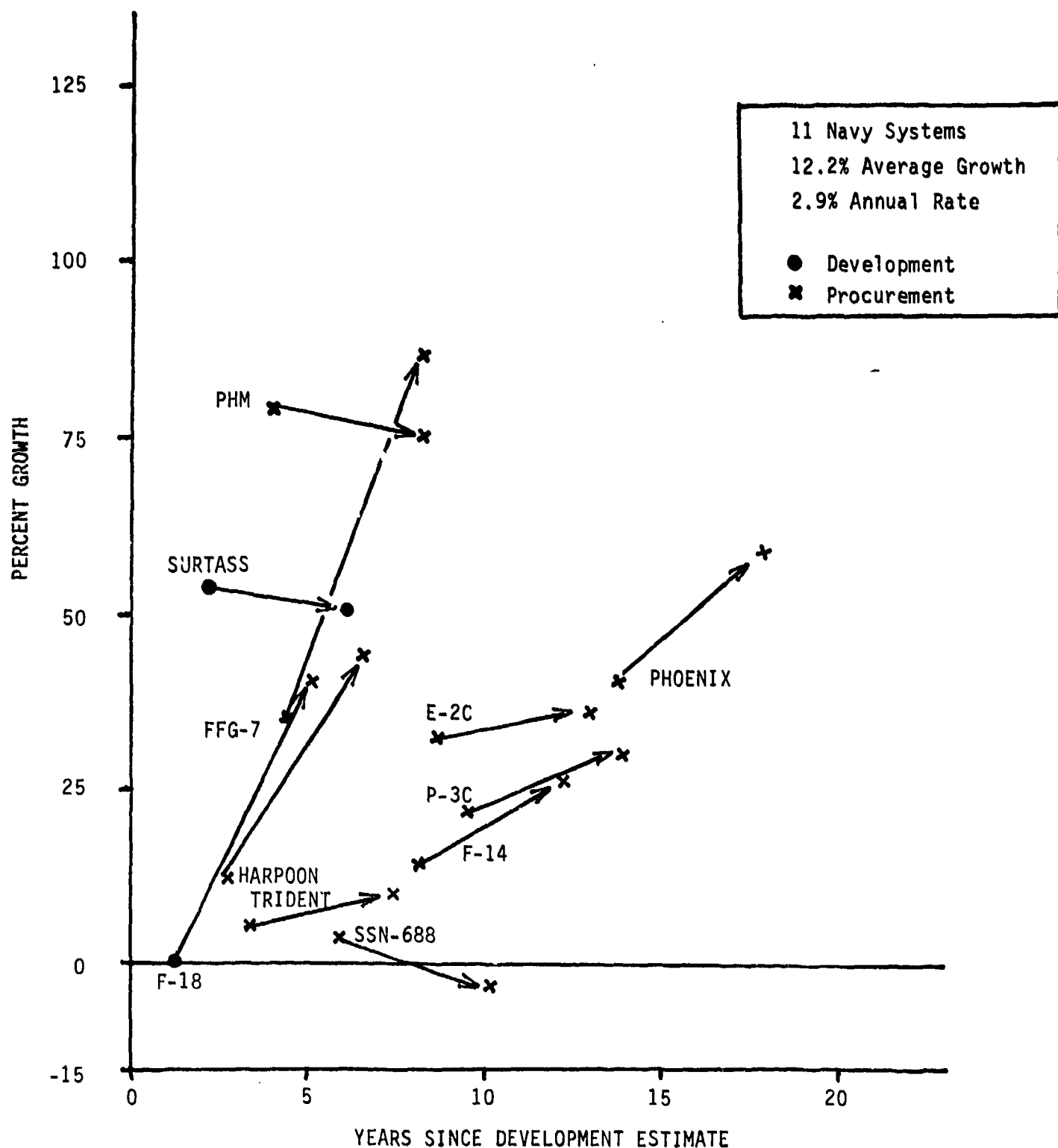
## (BASE YEAR \$, DE ADJUSTED FOR QUANTITY)



THE COST GROWTH STATUS FOR THE ELEVEN NAVY SYSTEMS IS DISPLAYED. MOST SYSTEMS EXHIBIT NOMINAL COST GROWTH OR REDUCTIONS IN COST GROWTH OVER THE PERIOD. MOST OF THESE PROGRAMS WERE IN PROCUREMENT DURING THE PERIOD.

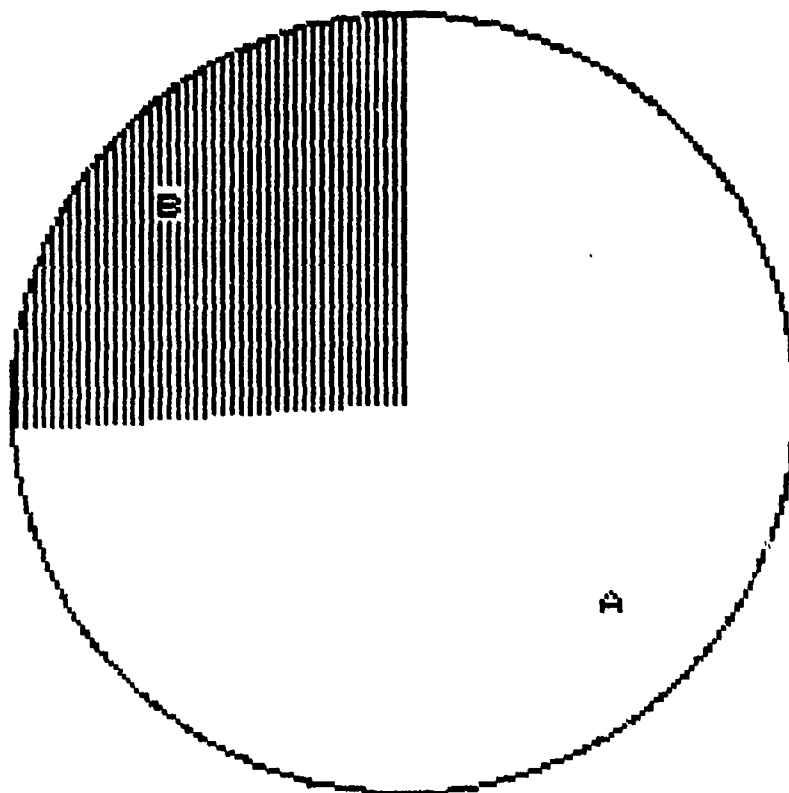
# COST GROWTH - 12/76 TO 12/80

## (BASE YEAR \$, DE ADJUSTED FOR QUANTITY)



THE TOTAL COST GROWTH FOR THE 55 SAR SYSTEMS  
IS DIVIDED INTO TOTAL ESCALATION AND BASE-YEAR  
DOLLAR CHANGES. ESCALATION ACCOUNTS FOR ALMOST  
THREE-QUARTERS OF THE TOTAL COST GROWTH.

# **COST GROWTH BY CATEGORY - ALL SERVICES (ESCALATION vs BASE YEAR)**



A-TOTAL ESCALATION = 73.9%

B-BASE YEAR DOLLAR CHANGES = 26.1%

TOTAL = 100.0%

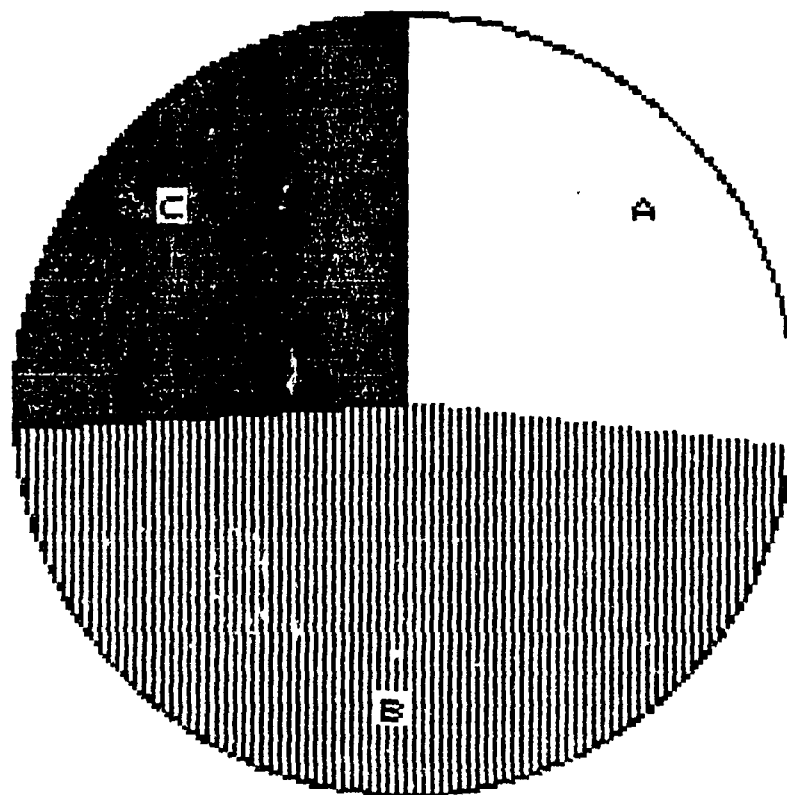
THE TOTAL ESCALATION IS DIVIDED INTO ECONOMIC ESCALATION AND PROGRAM CHANGE RELATED ESCALATION. ECONOMIC ESCALATION, OR ESCALATION DUE TO INCREASED INFLATION RATES, USED IN PREPARING THE CURRENT ESTIMATES ACCOUNTS FOR 26.9% OF THE TOTAL COST GROWTH. THE PROGRAM CHANGE RELATED ESCALATION OF 47.0% IS THE INFLATIONARY IMPACT OF THE BASE-YEAR DOLLAR CHANGES MADE TO PROGRAMS (E.G., DUE TO QUANTITY, SCHEDULE, ENGINEERING, SUPPORT, OR ESTIMATING CHANGES).



# COST GROWTH BY CATEGORY

## - ALL SERVICES

### (TYPES OF ESCALATION)

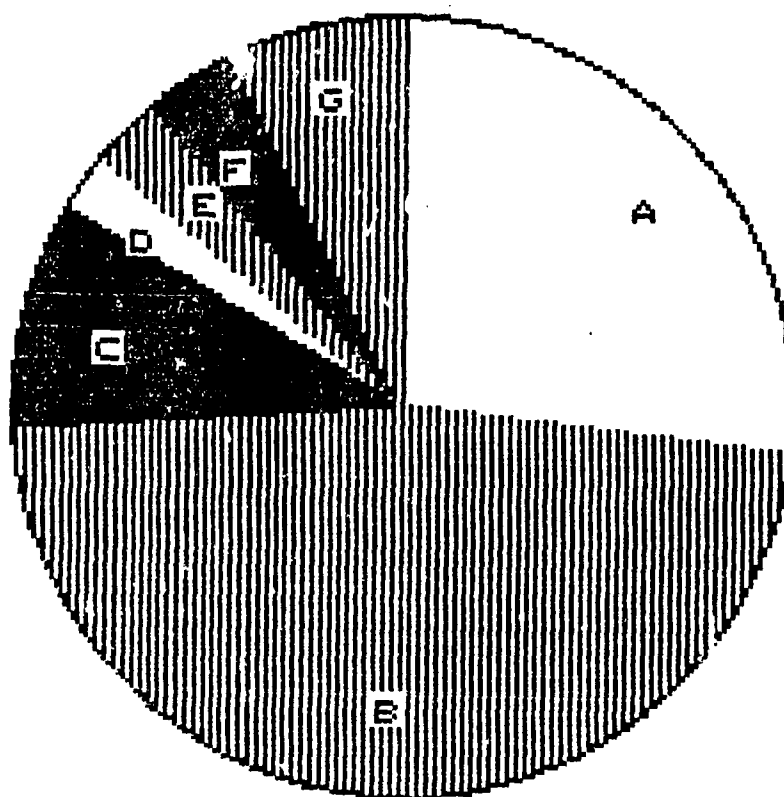


A-ECONOMIC ESCALATION	=	26.9%
B-PROGRAM CHANGE RELATED ESC	=	47.0%
C-BASE YEAR DOLLAR CHANGES	=	26.1%
TOTAL	=	100.0%

THE BASE-YEAR DOLLAR CHANGES ARE DIVIDED INTO THE VARIANCE CATEGORIES USED IN THE SAR TO REPORT PROGRAM CHANGES. QUANTITY CHANGES ACCOUNT FOR 9.4% OF THE TOTAL GROWTH; ENGINEERING, 2.5%; SUPPORT, 3.0%; SCHEDULE, 3.9%; AND ESTIMATING AND OTHER, 7.3% OF THE TOTAL COST GROWTH. THIS MAY BE SURPRISING TO MANY SINCE WE OFTEN BLAME "ENGINEERING CHANGE PROPOSALS (ECPs)" FOR MUCH OF COST GROWTH.

# COST GROWTH BY CATEGORY

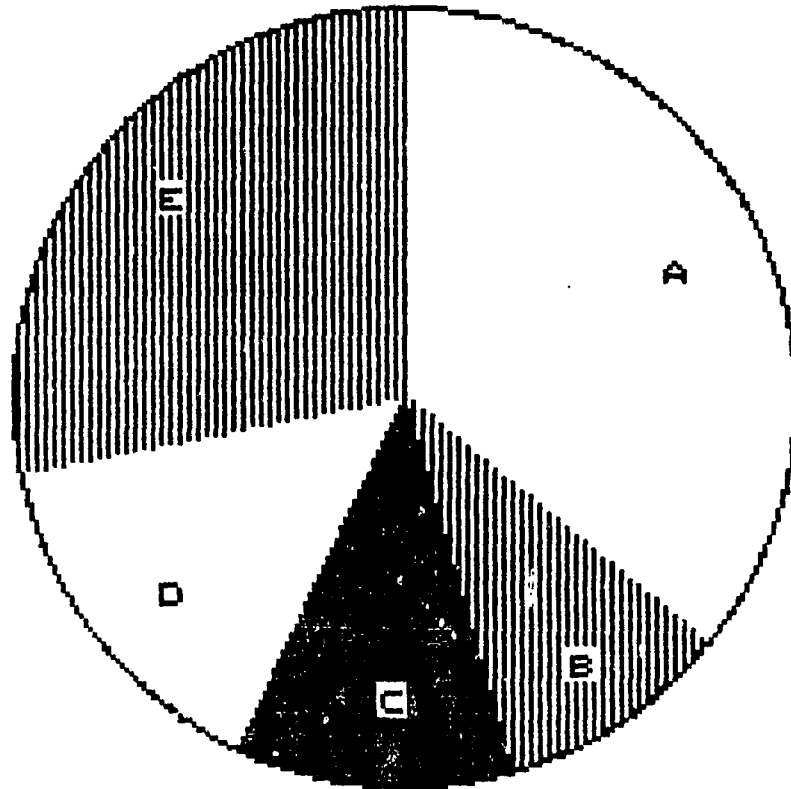
## - ALL SERVICES (INCLUDING BREAKOUT OF BASE YEAR DOLLAR CHANGES)



A-ECONOMIC ESCALATION	=	26.9%
B-PROGRAM CHANGE RELATED ESC	=	47.0%
C-QUANTITY	=	9.4%
D-ENGINEERING	=	2.5%
E-SUPPORT	=	3.0%
F-SCHEDULE	=	3.9%
G-ESTIMATING AND OTHER	=	7.3%
TOTAL		= 100.0%

THE 26.1% OF TOTAL COST GROWTH DUE TO BASE-YEAR DOLLAR CHANGES IS CONSIDERED HERE. OF THE CONSTANT OR BASE-YEAR DOLLAR CHANGES, QUANTITY IS THE REASON FOR 36.0% OF THE COST GROWTH; ENGINEERING, 9.6%; SUPPORT, 11.5%; SCHEDULE, 14.8%; AND ESTIMATING AND OTHER, 28.1%. WHILE QUANTITY CHANGES ACCOUNT FOR THE LARGEST PERCENTAGE, THE HIGH ESTIMATING COST GROWTH INDICATES THAT MANY SYSTEMS HAVE HAD THEIR COST RAISED DUE SOLELY TO RE-ESTIMATING RATHER THAN TO ANY DIRECT PROGRAM CHANGES. THIS MAY INDICATE THAT POOR INITIAL ESTIMATES WERE MADE. THE APPENDIX NOTES THAT \$5.9B OUT OF \$14.0B (42%) OF THE QUARTERLY BASE-YEAR DOLLAR CHANGES (SEPTEMBER-DECEMBER) WERE DUE TO ESTIMATING ERROR.

# COST GROWTH BY CATEGORY - ALL SERVICES (BASE YEAR DOLLAR CHANGES)



A-QUANTITY	=	36.0%
B-ENGINEERING	=	9.6%
C-SUPPORT	=	11.5%
D-SCHEDULE	=	14.8%
E-ESTIMATING AND OTHER	=	28.1%
TOTAL	=	100.0%

THE MAJOR CONCLUSIONS OF THIS BRIEF ANALYSIS  
OF THE DECEMBER 1980 SARs ARE PRESENTED.

## CONCLUSIONS

### "NUMBERS TO RETAIN"

- THE \$318.0B FOR 55 SAR SYSTEMS IS 129.9% ABOVE THE \$138.3B BUT, THIS IS ONLY 25.4% GROWTH IN CONSTANT "BASE YEAR" DOLLARS
- THE THREE SERVICES EXPERIENCED SUBSTANTIALLY DIFFERENT COST GROWTH (35.2%-A, 23.9%-AF, 22.9%-N)
- THE 19 SYSTEMS STILL IN DEVELOPMENT SHOW A 23.0% GROWTH, COMPARED TO 25.9% GROWTH CALCULATED FOR THE 36 SYSTEMS NOW IN PROCUREMENT; THIS MAY IMPLY DEVELOPMENT COST GROWTH PROBLEM
- THE 55 SARs HAVE EXPERIENCED \$169.6B IN INFLATION OF WHICH \$36.9B WAS ANTICIPATED IN THE DE. THUS \$132.7B OR 74% IS UNANTICIPATED INFLATION
- ON AN ANNUALIZED BASIS, THE GROWTH RATE OF 3.9% IS ABOUT THE SAME AS 5 YEARS AGO (3.7%)
- THE CONSTANT DOLLAR GROWTH (26%) IS COMPOSED OF QUANTITY CHANGES (36%), ESTIMATING (28%), SCHEDULE (15%), SUPPORT (11%), ENGINEERING (10%)

## APPENDIX



THIS APPENDIX CONTAINS ADDITIONAL DETAILED  
DEFINITIONS, DATA AND ANALYSIS RESULTS AS NOTED.

OF PARTICULAR INTEREST ARE THE QUARTERLY GROWTH  
CHARTS. THEY NOTE THAT \$50B OF COST INCREASES WAS  
EXPERIENCED IN ONE QUARTER - THE LARGEST AMOUNT EVER  
SEEN.

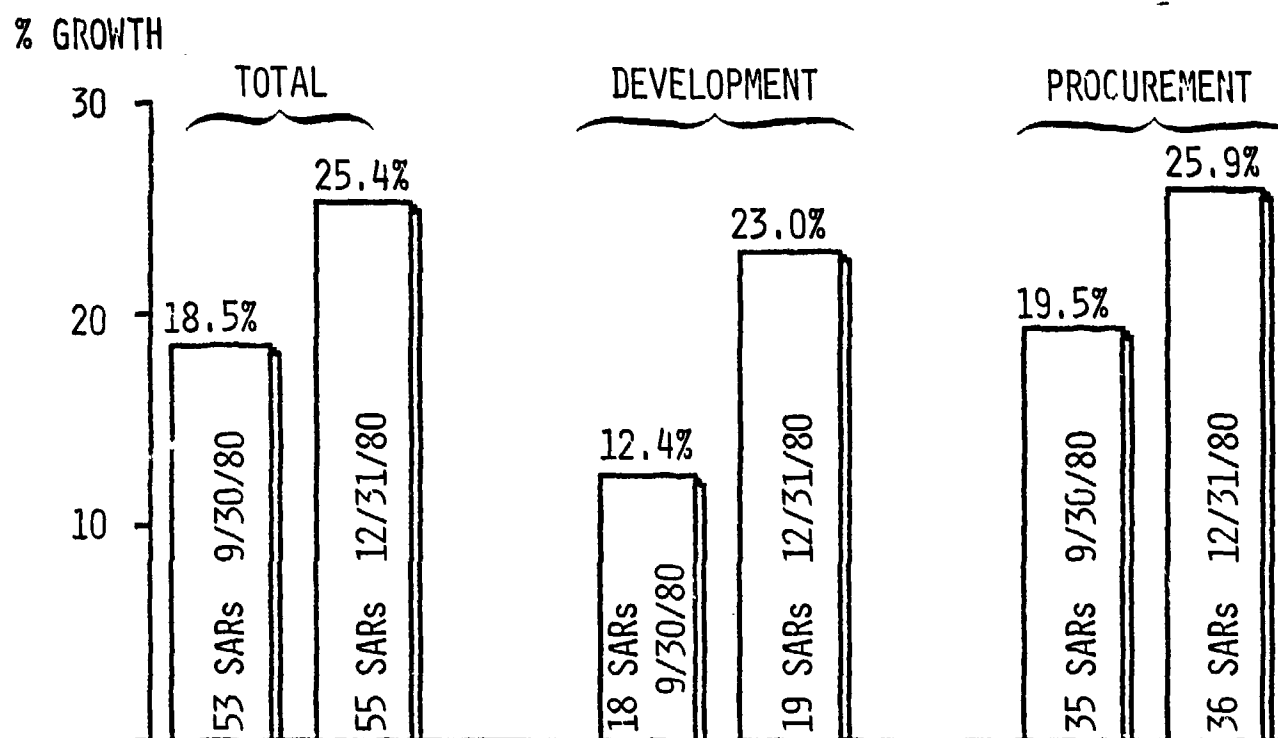
# BACK-UP CONTENTS

- SAR QUARTERLY GROWTH (30 SEPTEMBER-31 DECEMBER 1980)
- DEFINITIONS
- BASE YEAR \$ RESULTS
- THEN YEAR \$ RESULTS
- COST GROWTH BY CATEGORY BY SERVICE
- TOTAL DOLLAR COST GROWTH CHARTS
- PER-PROGRAM AVERAGE COST GROWTH
- E-2C PROGRAM COST HISTORY
- ANNUALIZED PROGRAM COST GROWTH CHART
- GROWTH RATE DATA
- ANALYSIS OF DSARC II vs DCP DATES

**SAR QUARTERLY GROWTH**  
**(30 SEPTEMBER 1980 – 31 DECEMBER 1980)**

AN ANALYSIS OF REAL COST GROWTH WAS ALSO PERFORMED ON THE 30 SEPTEMBER 1980 SARs. A COMPARISON OF THESE RESULTS TO THE 31 DECEMBER 1980 RESULTS SHOWS MAJOR DIFFERENCES. THE AVERAGE COST GROWTH FOR SYSTEMS IN DEVELOPMENT HAS ALMOST DOUBLED. THIS CHANGE NEEDS TO BE STUDIED THOUGH IT MAY MERELY REFLECT A CHANGE IN THE ADMINISTRATION'S APPROACH TO THE COST OF WEAPON SYSTEMS.

# COMPARISON OF REAL COST GROWTH BY ACQUISITION PHASE 30 SEPTEMBER 1980 TO 31 DECEMBER 1980 (DE ADJUSTED FOR QUANTITY)

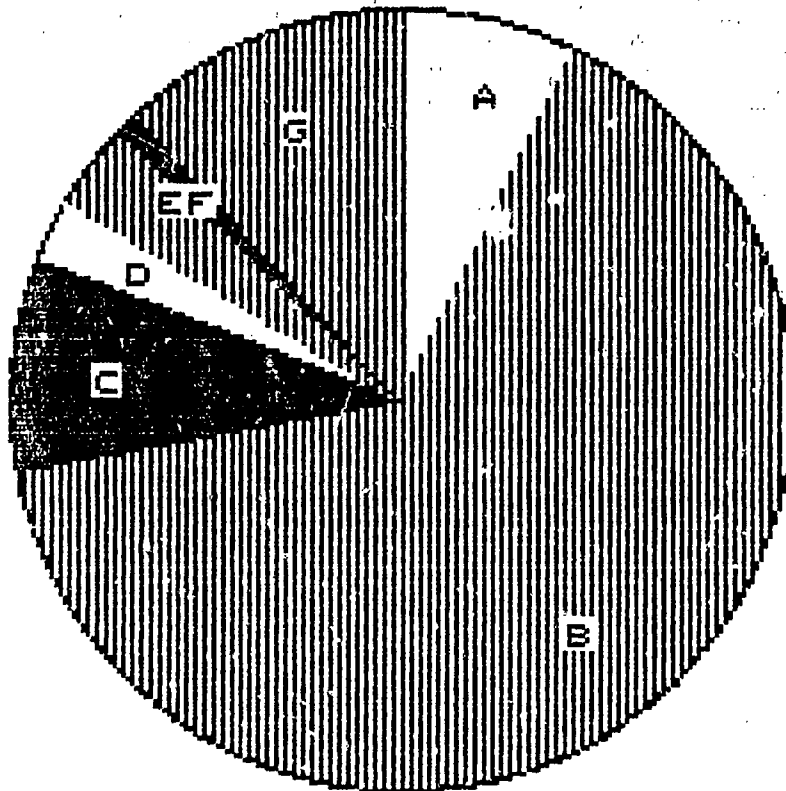


THE QUARTERLY CHANGE WAS OVER \$50B, THE LARGEST IN SAR HISTORY. THE BASIC REASONS FOR THIS GROWTH ARE SHOWN HERE. BY FAR THE LARGEST GROWTH IS THE ESCALATION RELATED TO PROGRAM CHANGES. OF PARTICULAR CONCERN IS THE CONSTANT OR BASE-YEAR DOLLAR GROWTH DUE TO ESTIMATING/OTHER. ESTIMATING ACCOUNTS FOR 42% (\$5.9B OUT OF \$14.0B) OF THE BASE-YEAR DOLLAR CHANGES.

# SAR QUARTERLY GROWTH

## (30 SEPTEMBER 1980 - 31 DECEMBER 1980)

• \$50.1B GROWTH THIS QUARTER



A-ECONOMIC ESCALATION	= \$ 3.6B
B-PROGRAM CHANGE RELATED ESC	= \$32.5B
C-QUANTITY	= \$ 4.4B
D-ENGINEERING	= \$ 1.4B
E-SUPPORT	= \$ 1.7B
F-SCHEDULE	= \$ 0.6B
G-ESTIMATING/OTHER	= \$ 5.9B
<b>TOTAL</b>	<b>= \$50.1B</b>

THE \$5.9B OF BASE-YEAR DOLLAR ESTIMATING CHANGES  
IS DUE PRINCIPALLY TO FIVE MAJOR WEAPON SYSTEMS:

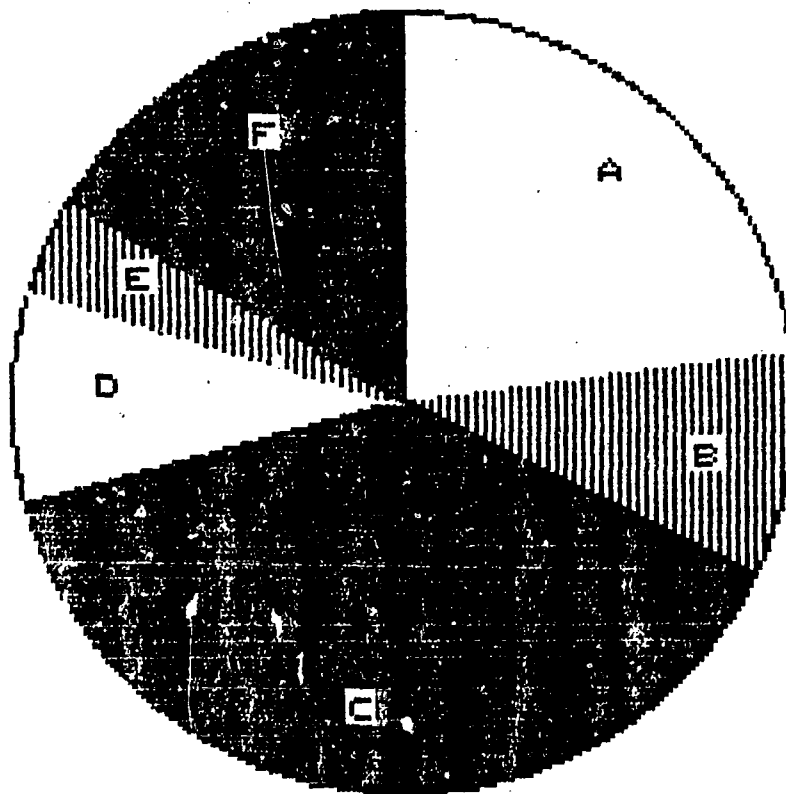
- XM-1
- FVS (MICV)
- F-18
- CG-47
- ALCM

THESE SYSTEMS NEED TO BE WATCHED CAREFULLY.



# SAR QUARTERLY GROWTH (30 SEPTEMBER 1980 - 31 DECEMBER 1980)

- \$5.9B ESTIMATING GROWTH THIS QUARTER



A-XM-1 (ARMY)	=	\$1342.8 M
B-FVS (MICV) (ARMY)	=	\$ 548.0 M
C-F-18 (NAVY)	=	\$2251.6 M
D-CG-47 (NAVY)	=	\$ 539.2 M
E-ALCM (AIR FORCE)	=	\$ 237.3 M
F-ALL OTHERS	=	\$ 941.1 M
TOTAL		= \$5860.0 M

## DEFINITIONS

## DEFINITIONS

An analysis of cost growth in weapon systems depends on several major considerations:

- Whether changes in quantity are taken into account:
  - SAR program values are frequently presented (by GAO and Congress) as totals even though procurement quantities are often changed over 10-15 year periods between the Development Estimate and Current Estimate. We call this "Unadjusted" cost growth. But quantity changes should be reflected in the analysis.
  - Two methods exist for making the quantity adjustment. The Current Estimate can be adjusted for cost due to quantity changes back to the Development Estimate quantity; alternatively, the Development Estimate can be adjusted for cost due to quantity up to the Current Estimate quantity.
  - The first method stabilizes the quantity at that level used in the original Development Estimate (DE). This is useful for tracking an estimate over time since the quantity tracked is always that of the DE. The second method adjusts the Development Estimate to the quantity currently being considered. This latter method of adjustment is used by OSD, but does not allow comparison between quarterly reports at a constant quantity. For examining Then-Year costs, only the DE adjustment was used so as to be consistent with GAO and Congressional data.
- Whether escalation has been separated out:
  - SAR program estimates have been prepared (since 1975) in both Base-Year (constant) and Then-Year (inflated) dollars even though projecting inflation over the next five years (escalation) is extremely uncertain. An apparently small change in Base-Year dollars (e.g., schedule slippage) can cause a large change in Then-Year dollars due to both Economic Escalation and Program Change Related Escalation.

- Whether growth is computed for all programs at the same stage of development (acquisition phase):
  - Cost tends to increase (even in constant dollars) as a program matures. Thus, cost growth for a set of programs still in RDT&E is probably far less than that for a set of programs in production. Aggregating all programs, irrespective of age or maturity, tends to hide the full magnitude of the cost growth.
- Whether growth is considered on a total gross dollar basis or on a per-program average basis:
  - Smaller dollar value systems tend to grow more (on a percentage basis) than large programs. Unless broken out on a per-program basis, the poorer performance on the smaller programs is hidden by the greater cost stability of the larger ones.
  - This briefing shows cost growth aggregations both on a total basis and on an average percent growth per-program basis.

Cost growth in this briefing accounts for the considerations above. Particular definitions relevant to the discussion below are as follows:

- Development Estimate - These are the estimates made at the time the program passes Milestone II (DSARC II) and enters full scale engineering development.
- Current Estimate - This is the December 1980 cost estimate reported by the Project Manager. It is the amount of the Development Estimate plus all cost changes to the program due to various causes including escalation and quantity.
- Cost due to Quantity Changes - These are the costs associated with a change in the quantity requirements between the Development Estimate and the Current Estimate.
- Base-Year Dollars - This item refers to constant dollars of the year in which the original Development Estimate was made.
- Then-Year Dollars - This term refers to current dollars which are Base-Year dollars inflated to current levels by applying the annual escalation rates.
- Cost due to Other Program Changes - The cost encompasses changes due to reasons other than quantity, including engineering, support, schedule estimating error and "other" reasons.

- Program Change Related Escalation - The escalation associated with Program Changes is added to the Base-Year costs to obtain Then-Year dollar estimates.
- Economic Escalation - This escalation pertains to those changes which result solely from economic conditions. Many people use the term inflation to represent historical price level changes, and escalation to represent those changes predicted to occur in the future. A change in escalation rate from 6% to 8% annually would result in an Economic cost increase to the program.

Results below show the detailed analysis by weapon system. Both tabular and graphic representations are used to illustrate results in terms of:

- "Base-Year" or constant dollar cost growth as well as "Then-Year" or current (escalated) dollar cost growth,
- Individual weapon system,
- Type of system (Army, Air Force, Navy),
- Acquisition Phase (Development or Procurement).

The remainder of the report contains detailed listings of individual weapon system programs.